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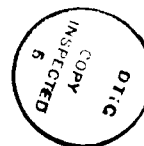
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High Temperature Superconducting Materials: Thin Films, Surfaces, and Interfaces

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- a. Number of papers submitted to refereed journals, but not published (list attached): 1
- b. Number of papers published in refereed journals (list attached): 39
- c. Number of books or chapters submitted, but not yet published: 0
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 - Female Graduate Students: 0
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 - Minority Post-Doctoral Associates: 0and, the number of
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 - Asian Post-Doctoral Associates: 3

Part I

a. Papers Submitted to Refereed Journals (and not yet published)

1. T.R. Ohno, G.H. Kroll, J.H. Weaver, Y. Kimachi, and Y. Hidaka, "Reactivity of Atmospheric Gases with $\text{Bi}_2\text{Sr}_2\text{CaCu}_2\text{O}_8(001)$ and $\text{YBa}_2\text{Cu}_3\text{O}_7(001)$ Surfaces," J. Mater. Res. (submitted).

b. Papers Published in Refereed Journals

1. T.J. Wagener, Y. Gao, J.H. Weaver, A.J. Arko, B. Flandermeyer, and D.W. Capone II, "Unoccupied Electronic States and Surface Phenomena for $\text{YBa}_2\text{Cu}_3\text{O}_{6.9}$," Phys. Rev. B **36**, 3899-3903 (1987).
2. Y. Gao, T.J. Wagener, J.H. Weaver, A.J. Arko, B. Flandermeyer, and D.W. Capone II, "Inverse Photoemission Studies of the Empty Electronic States and Surface Stability of $\text{La}_{1.85}\text{Sr}_{0.15}\text{CuO}_4$," Phys. Rev. Rapid Commun. B **36**, 3971-3974(1987).
3. J.H. Weaver, Y. Gao, T.J. Wagener, B. Flandermeyer, and D.W. Capone II, "Reaction and Disruption for $\text{Fe/La}_{1.85}\text{Sr}_{0.15}\text{CuO}_4$: Interface Formation for High-Temperature Superconductors," Phys. Rev. Rapid Commun. B **36**, 3975-3978 (1987).
4. D.M. Hill, H.M. Meyer III, and J.H. Weaver, B. Flandermeyer, and D.W. Capone II, "Oxygen Withdrawal, Copper Valency, and Interface Reaction for $\text{Fe/La}_{1.85}\text{Sr}_{0.15}\text{CuO}_4$," Phys. Rev. Rapid Commun. B **36**, 3979-3982 (1987).
5. Y. Gao, T.J. Wagener, J.H. Weaver, B. Flandermeyer, and D.W. Capone II, "Reaction and Intermixing for Metal- Superconductor Interfaces: $\text{Fe/YBa}_2\text{Cu}_3\text{O}_{6.9}$," Appl. Phys. Lett. **51**, 1032-1034 (1987).
6. H.M. Meyer III, T.J. Wagener, D.M. Hill, Y. Gao, S.G. Anderson, S.D. Krahn, J.H. Weaver, B. Flandermeyer, and D.W. Capone II, "Spectroscopic Evidence for Passivation of the $\text{La}_{1.85}\text{Sr}_{0.15}\text{CuO}_4$ Surface with Gold," Appl. Phys. Lett. **51**, 1118-1120 (1987).
7. H.M. Meyer III, D.M. Hill, Steven G. Anderson, J.H. Weaver, and D.W. Capone II, "Titanium-Oxygen Reaction at the $\text{Ti/La}_{1.85}\text{Sr}_{0.15}\text{CuO}_4$ Interface," Appl. Phys. Lett. **51**, 1750-1752 (1987).
8. D.M. Hill, Y. Gao, H.M. Meyer III, T.J. Wagener, J.H. Weaver, and D.W. Capone II, "Cu-Induced Surface Disruption of $\text{La}_{1.85}\text{Sr}_{0.15}\text{CuO}_4$," Phys. Rev. B **37**, 511-514 (1988).
9. Y. Gao, T.J. Wagener, J.H. Weaver, and D.W. Capone II, "Interface Formation of Semiconductors with High T_c Superconductors: $\text{Ge/La}_{1.85}\text{Sr}_{0.15}\text{CuO}_4$," Phys. Rev. B **37**, 515-518 (1988).
10. H.M. Meyer III, Y. Gao, D.M. Hill, T.J. Wagener, J.H. Weaver, B. Flandermeyer, and D.W. Capone II, "High Temperature Superconductors: Occupied and Unoccupied Electronic States," in *Thin Film Processing and Characterization of High Temperature Superconductors*, edited by J.M.E. Harper, R.J. Colton, and L.C. Feldman, AIP Conference Proceedings **165**, 254-263 (1988).
11. T.J. Wagener, Y. Gao, H.M. Meyer III, D.M. Hill, J.H. Weaver, B. Flandermeyer, and D.W. Capone II, "Spectroscopic Examinations of the Surface Stability of High Temperature Superconductors," in *Thin Film Processing and Characterization of High Temperature Superconductors*, edited by J.M.E. Harper, R.J. Colton, and L.C. Feldman, AIP Conference Proceedings **165**, 368-373 (1988).

12. Y. Gao, H.M. Meyer III, T.J. Wagener, D.M. Hill, S.G. Anderson, J.H. Weaver, B. Flandermeyer, and D.W. Capone II, "Interface Formation: High Temperature Superconductors with Noble Metals, Reactive Transition Metals, and Semiconductors," in *Thin Film Processing and Characterization of High Temperature Superconductors*, edited by J.M.E. Harper, R.J. Colton, and L.C. Feldman, AIP Conference Proceedings **165**, 358-367 (1988).
13. Y. Gao, I.M. Vitomirov, C.M. Aldao, T.J. Wagener, J.J. Joyce, C. Capasso, J.H. Weaver, and D.W. Capone II, "Synchrotron Radiation Photoemission Studies of Interface Formation between Metals and Superconductors: Al and In on $\text{YBa}_2\text{Cu}_3\text{O}_{6.9}$," *Phys. Rev. B - Rapid Commun.* **37**, 3741-3744 (1988).
14. T.J. Wagener, Y. Gao, I.M. Vitomirov, C.M. Aldao, J.J. Joyce, C. Capasso, J.H. Weaver, and D.W. Capone II, "Disruption, Segregation, and Passivation for Pd and Noble Metal Overlayers on $\text{YBa}_2\text{Cu}_3\text{O}_{6.9}$," *Phys. Rev. B* **38**, 232-239 (1988).
15. J.H. Weaver, H.M. Meyer III, T.J. Wagener, D.M. Hill, Y. Gao, D. Peterson, Z. Fisk, and A.J. Arko, "Valence Bands, Oxygen in Planes and Chains, and Surface Changes for Single Crystals of M_2CuO_4 and $\text{M}\text{Ba}_2\text{Cu}_3\text{O}_x$ ($\text{M} = \text{Pr, Nd, Eu, Gd}$)," *Phys. Rev. B* **38**, 4668-4676 (1988).
16. Y. Gao, T.J. Wagener, C.M. Aldao, I.M. Vitomirov, J.H. Weaver, and D.W. Capone II, "Photoemission and Inverse Photoemission Studies of La Adatom Interactions with $\text{YBa}_2\text{Cu}_3\text{O}_{6.9}$," *J. Appl. Phys.* **64**, 1296-1300 (1988).
17. H. M. Meyer III, D.M. Hill, T.J. Wagener, J.H. Weaver, and D.W. Capone II, "Electronic Structures of the $\text{YBa}_2\text{Cu}_3\text{O}_{6.9}$ Surface and Its Modification by Sputtering and Adatoms of Ti and Cu," *Phys. Rev. B* **38**, 6500-6512 (1988).
18. H.M. Meyer III, D.M. Hill, J.H. Weaver, D.L. Nelson, and C.F. Gallo, "Occupied Electronic States of Single Crystal $\text{Bi}_2\text{Ca}_{1+x}\text{Sr}_{2-x}\text{Cu}_2\text{O}_{8+y}$ " *Phys. Rev. B Rapid Commun.* **38**, 7144-7147 (1988).
19. D.M. Hill, H.M. Meyer III, J.H. Weaver, C.F. Gallo, and K.C. Goretta, "Cu Adatom Interactions with Single- and Polycrystalline $\text{Bi}_2\text{Ca}_{1+x}\text{Sr}_{2-x}\text{Cu}_2\text{O}_{8+y}$ and $\text{YBa}_2\text{Cu}_3\text{O}_x$," *Phys. Rev. B* **38**, 11331-11336 (1988).
20. H.M. Meyer III, D.M. Hill, J.H. Weaver, D.L. Nelson, and K.C. Goretta, "Reactivity and Passivation for Bi Adatoms on $\text{YBa}_2\text{Cu}_3\text{O}_{6.9}$ and $\text{Bi}_2\text{Ca}_{1+x}\text{Sr}_{2-x}\text{Cu}_2\text{O}_{8+y}$," *Appl. Phys. Lett.* **53**, 1004-1006 (1988).
21. D.M. Hill, H.M. Meyer III, J.H. Weaver, and D.L. Nelson, "Passivation of High T_c Superconductor Surfaces with CaF_2 and Bi, Al, and Si Oxides," *Appl. Phys. Lett.* **53**, 1657-1659 (1988).
22. T.J. Wagener, Yongjun Hu, Y. Gao, M.B. Jost, J.H. Weaver, N. Spencer, and K.C. Goretta, "Resonant Inverse Photoemission of $\text{Bi}_2\text{Ca}_{1+x}\text{Sr}_{2-x}\text{Cu}_2\text{O}_{8+y}$ and $\text{YBa}_2\text{Cu}_3\text{O}_{6.9}$, Unoccupied Oxygen States, and Plasmons," *Phys. Rev. B - Rapid Commun.* **29**, 2928-2931 (1989).
23. H.M. Meyer III, D.M. Hill, T.J. Wagener, J.H. Weaver, C.F. Gallo, K.C. Goretta, "Single Crystal $\text{YBa}_2\text{Cu}_3\text{O}_{7-x}$ and $\text{Bi}_2\text{Ca}_{1+x}\text{Sr}_{2-x}\text{Cu}_2\text{O}_{8+y}$ Surfaces and Ag Adatom-Induced Modification," *J. Appl. Phys.* **65**, 3130-3135 (1989).
24. J.H. Weaver, H.M. Meyer III, T.J. Wagener, D.M. Hill, and Y. Hu, "Surface and Interface Properties of High Temperature Superconductors," *American Institute of Physics Conference Proceedings* **182**, 399-408 (1989).

25. H.M. Meyer III, T.J. Wagener, and J.H. Weaver, "Photoemission and Inverse Resonant Photoemission Studies of $\text{Ti}_2\text{Ba}_2\text{Ca}_2\text{Cu}_3\text{O}_{10+y}$," *Phys. Rev B - Rapid Commun.* **39**, 7343-7346 (1989).
26. D.M. Hill, H.M. Meyer III, and J.H. Weaver, "Y, Ba, Cu and Ti Interface Reactions with $\text{SrTiO}_3(100)$ Surfaces," *J. Appl. Phys.* **65**, 4943-4950 (1989).
27. T.J. Wagener, H.M. Meyer III, D.M. Hill, Y. Hu, M.B. Jost, J.H. Weaver, and D.G. Hinks, "Photoemission and Inverse Photoemission Studies of $\text{Ba}_{1-x}\text{K}_x\text{BiO}_{3-y}$," *Phys. Rev. B* **40**, 4532-4537 (1989).
28. D.M. Hill, H.M. Meyer III, and J.H. Weaver, "Ba Oxides: Core Level Binding Energies and Defect-Related Fermi Level Pinning," *Surface Science* **225**, 63-71 (1990).
29. H.M. Meyer III, J.H. Weaver, and K.C. Goretta, "Surface Reactivity and Interface Morphology for Ti Growth on $\text{YBa}_2\text{Cu}_3\text{O}_{7-x}$, Y_2BaCuO_5 , and CuO ," *J. Appl. Phys.* **67**, 1995-2002 (1990).
30. T.J. Wagener, H.M. Meyer III, Yongjun Hu, M.B. Jost, J.H. Weaver, and K.C. Goretta, "O 2p Holes: Temperature Effects and Surface Characteristics of Cuprate Superconductors," *Phys. Rev. B* **41**, 5817-5824 (1990).
31. T.J. Wagener, Y. Hu, M.B. Jost, and J.H. Weaver, " $\text{YBa}_2\text{Cu}_3\text{O}_{7-x}$ (001) Studied at 60 K with Momentum-Resolved Inverse Photoemission," *Phys. Rev. B - Rapid Commun.* **42**, 1041-1044 (1990).
32. T.R. Ohno, J.C. Patrin, H.M. Meyer, J.H. Weaver, Y. Kimachi, and Y. Hidaka, "Atom- and Cluster-Assembled Interfaces: $\text{Cr/Bi}_2\text{Sr}_{2-x}\text{Ca}_{1+x}\text{Cu}_2\text{O}_{8+y}$," *Phys. Rev. B - Rapid Commun.* **41**, 11677-11680 (1990).
33. T.R. Ohno, Y.-N. Yang, J.H. Weaver, Y. Kimachi, and Y. Hidaka, "Ge on $\text{Bi}_2\text{Sr}_{2-x}\text{Ca}_{1+x}\text{Cu}_2\text{O}_{8+y}$: Reduced Reactivity through Cluster Assembly," *Appl. Phys. Lett.* **57**, 718-720 (1990).
34. T.J. Wagener, Y.-J. Hu, M.B. Jost, J.H. Weaver, Y.F. Yan, X. Chu, and Z.X. Zhao, "Comparison of the Empty Electronic States of $\text{Bi}_2\text{Sr}_2\text{CaCu}_2\text{O}_8$ (001) and $\text{Bi}_2\text{Sr}_2\text{Cu}_2\text{O}_6$ (001) at 60 K and 300 K," *Phys. Rev. B* **42**, 6317-6321 (1990).
35. D.M. Hill, H.M. Meyer III, and J.H. Weaver, "Silicon Interfaces with High Temperature Superconductors," *Surf. Sci.* **236**, 377-384 (1990).
36. H.M. Meyer, D.M. Hill, J.H. Weaver, K.C. Goretta, and U. Galachandran, "Ni/ $\text{YBa}_2\text{Cu}_3\text{O}_{7-x}$ and Ni/ $\text{Bi}_2\text{Sr}_2\text{Ca}_{0.8}\text{Y}_{0.2}\text{Cu}_2\text{O}_x$ Interface Formation: Reactivity, Segregation, and Chemical Trapping," *J. Mat. Res.* **6**, 270-277 (1991).
37. Y. Kimachi, Y. Hidaka, T.R. Ohno, G.H. Kroll, and J.H. Weaver, "Reactive Metal Overlayer Formation on High Temperature Superconductors at 20 K," *J. Appl. Phys.* **69**, 3176-3181 (1991).
38. T.R. Ohno, Y.-N. Yang, G.H. Kroll, K. Krause, L.D. Schmidt, J.H. Weaver, Y. Kimachi, Y. Hidaka, S.H. Pan, and A.L. de Lozanne, "Cluster-Assembled Overlayers and High-Temperature Superconductors," *Phys. Rev. B* **43**, 7980-7990 (1991).
39. T. Komeda, G.D. Waddill, P.J. Benning, and J.H. Weaver, "Photoelectron Microscopy and Spectroscopy of $\text{Bi}_2\text{Sr}_{2-x}\text{Ca}_{1+x}\text{Cu}_2\text{O}_{8+y}$ (100)," *Phys. Rev. B* **43**, 8713-8716 (1991).

c. Books (and sections thereof) Submitted for Publication

None

d. Books (and sections thereof) Published

1. Y. Gao, T.J. Wagener, D.M. Hill, H.M. Meyer III, J.H. Weaver, A.J. Arko, B. Flandermeyer, and D.W. Capone II, "High T_c Superconductors: Occupied and Unoccupied Electronic States, Surface Stability, and Interface Formation," Chapter 21 in *Chemistry of High-Temperature Superconductors*, David L. Nelson, M. Stanley Whittingham, and Thomas F. George, eds., (American Chemical Society, Washington, D.C., 1987) pp 212-225.
2. D. Sahn, A. Langner, T.F. George, J.H. Weaver, H.M. Meyer III, D.L. Nelson, and A. Wold, "Overview of High Temperature Superconductivity: Theory, Surfaces, Interfaces, and Bulk Systems," Chapter 1 in *Physical Chemistry of High Temperature Superconductors*, Thomas F. George and David L. Nelson, eds. (American Chemical Society, Washington, D.C., 1988) pp 1-15.
3. H.M. Meyer III, D.M. Hill, J.H. Weaver, and D.L. Nelson, "Surface and Interface Properties of High Temperature Superconductors," Chapter 21 in *Physical Chemistry of High Temperature Superconductors*, Thomas F. George and David L. Nelson, eds. (American Chemical Society, Washington, D.C., 1988) pp 280-290.
4. H.M. Meyer III and J.H. Weaver, "Electronic Structure, Surface Properties, and Interface Chemistry of High Temperature Superconductors," Chapter 6 in *Physical Properties of High Temperature Superconductors II*, D.M. Ginsberg, ed. (World Scientific, Inc., 1990) pp 369-457.

e. Technical Reports Published and Papers Published in Non-Refereed Journals

1. D.L. Nelson, D. Sahu, A. Langner, T.F. George, J.H. Weaver, H.M. Meyer, and A. Wold, "Overview of High Temperature Superconductivity: Theory, Surfaces, Interfaces, and Bulk Systems," Naval Research Reviews, Office of Naval Research, Four / 1988 - One / 1989, Vol. XL / XLI.
2. G.D. Waddill, T.R. Ohno, and J.H. Weaver, "Clusters and Cluster-Assembly of Interfaces," Proc. of the 1990 Fall Meeting of the Materials Research Society (in press).

f. Patents Filed

None

g. Patents Granted

J.H. Weaver, H.M. Meyer III, D.M. Hill, D.L. Nelson, and R.K. Grasselli, "CaF₂ Passivation Layers for High Temperature Superconductors," United States Letters Patent No. 4,965,244 dated October 23, 1990.

h. Invited Presentations at Topical or Scientific/Technical Society Conferences

1. J.H. Weaver, "High T_c Superconductors: Occupied and Unoccupied Electronic States, Surface Stability, and Interface Formation," American Chemical Society, New Orleans, Louisiana, September 1987.
2. J.H. Weaver, H.M. Meyer III, Y. Gao, D.M. Hill, T.J. Wagener, B. Flandermeyer, and D.W. Capone II, "High Temperature Superconductors: Occupied and Unoccupied Electronic States," 20th Annual Synchrotron Radiation Center Users Group Meeting, Stoughton, Wisconsin, October 1987.
3. J.H. Weaver, "High Temperature Superconductors," American Institute of Chemical Engineers Symposium, Minneapolis, Minnesota, February 1988.
4. J.H. Weaver, "Surface Stability and Interface Chemisorption of High Temperature Superconductors," Gordon Conference on the Chemistry of Electronic Materials, Ventura, California, March 1988.
5. J.H. Weaver, "High Temperature Superconductors: Electronic States, Surface Stability, and Interface Formation," American Chemical Society, Minneapolis, Minnesota, April 1988.
6. J.H. Weaver, "Electronic Structure of High Temperature Superconductors," Gordon Conference on Electron Spectroscopy, Brewster Academy, New Hampshire, July 1988.
7. J.H. Weaver, "High Temperature Superconductors: Electronic States, Surface Stability, and Interface Formation," American Chemical Society 196th National Meeting, Los Angeles, September 1988.
8. J.H. Weaver, "High Temperature Superconductors: Electronic States, Surface Stability, and Interface Formation," 35th National Symposium of the American Vacuum Society, Topical Conference on High T_c Superconducting Thin Films, Devices, and Characterization, Atlanta, Georgia, October 1988.
9. J.H. Weaver, "Surfaces and Interfaces of High Temperature Superconductors," First Gordon Conference on Superconductivity, Ventura, California, February 1989.
10. J.H. Weaver, "Photoemission Studies of Surfaces and Interfaces of High T_c Superconductors," Scanning Electron Microscopy Conference, Salt Lake City, Utah, May 1989.
11. J.H. Weaver, "Surfaces and Interfaces of High Temperature Superconductors" March Meeting of the American Physical Society, Anaheim, California, March 1990.
12. J.H. Weaver, "Surface and Interface Stability of High Temperature Superconductors," Chemistry of Advanced Materials, Cincinnati, Ohio, March 1991.
13. J.H. Weaver, "Interface Effects for High Temperature Superconductors," Materials Research Society, Anaheim, California, April 1991.
14. J.H. Weaver, "Interface Effects for High Temperature Superconductors," Electrochemical Society, Washington, DC, May 1991.
15. J.H. Weaver, Distinguished Lecturer, NSF Workshop on "Thin Film Science and Technology for the 21st Century," July/August 1991.

i. Contributed Presentations at Topical or Scientific/Technical Society Conferences

1. H.M. Meyer III, Y. Gao, D.M. Hill, T.J. Wagener, J.H. Weaver, B. Flandermeyer, and D.W. Capone II, "High Temperature Superconductors: Occupied and Unoccupied Electronic States," 34th National Symposium of the AVS, Anaheim, November 1987.
2. T.J. Wagener, Y. Gao, H.M. Meyer III, D.M. Hill, J.H. Weaver, B. Flandermeyer, and D.W. Capone II, "Spectroscopic Examinations of the Surface Stability of High Temperature Superconductors," 34th National Symposium of the AVS, Anaheim, November 1987.
3. Y. Gao, H.M. Meyer III, T.J. Wagener, D.M. Hill, S.G. Anderson, J.H. Weaver, B. Flandermeyer, and D.W. Capone II, "Interface Formation: High Temperature Superconductors with Noble Metals, Reactive Transition Metals, and Semiconductors," 34th National Symposium of the AVS, Anaheim, November 1987.
4. T.J. Wagener, H.M. Meyer III, D.M. Hill, Y. Gao, J.H. Weaver, K.C. Goretti, D. Peterson, D. Fisk, N. Spencer, and C.F. Gallo, "Occupied and Unoccupied Electronic States of High Temperature Superconductors," Topical Conference on High Temperature Superconductors, 35th National Symposium of the AVS, Atlanta, October 1988.
5. H.M. Meyer III, D.M. Hill, T.J. Wagener, P.J. Benning, J.H. Weaver, and D.L. Nelson, "Passivation, Contact Formation, and Reactivity of Vacuum Deposited Metals, Semiconductors, and Oxides on High Temperature Superconductors," Topical Conference on High Temperature Superconductors, 35th National Symposium of the AVS, Atlanta, October 1988.
6. D.M. Hill, H.M. Meyer III, and J.H. Weaver, "Interface Reactions and Atomic Distributions for Y, Ba, Cu, and Ti Overlayers on SrTiO₃(100)," Topical Conference on High Temperature Superconductors, 35th National Symposium of the AVS, Atlanta, October 1988.
7. Y. Gao, Y. Hu, T.J. Wagener, and J.H. Weaver, "Resonance Inverse Photoemission of Bi₂Ca_{2-x}Sr_{1+x}Cu₂O_{8+y} and YBa₂Cu₃O_{7-x}, Unoccupied Oxygen States, and Plasmons," March Meeting of the American Physical Society, St. Louis, March 1989.
8. T.J. Wagener, H.M. Meyer III, Y. Hu, M.B. Jost, and J.H. Weaver, "Occupied and Empty Electronic States of High Temperature Oxide Superconductors and Related Materials," 36th National Symposium of the AVS, Boston, October 1989.
9. H.M. Meyer III, T.J. Wagener, D.M. Hill, and J.H. Weaver, "Surface Reactivity of Cuprate Superconductors and Related Compounds," 36th National Symposium of the AVS, Boston, October 1989.
10. T.R. Ohno, Y.-N. Yang, G. Kroll, and J.H. Weaver, "Cluster-Assembled Metal-Semiconductor-HTS Interfaces," 37th National Symposium of the AVS, Toronto, October 1990.
11. P.J. Benning, G.D. Waddill, T. Komeda, and J.H. Weaver, "Photoelectron Spectroscopy using Synchrotron Radiation," 23rd Annual Synchrotron Radiation Users Group Meeting, Stoughton, Wisconsin, November 1990.
12. P.J. Benning, G.D. Waddill, T. Komeda, and J.H. Weaver, "Photoelectron Spectroscopy using Synchrotron Radiation," 13th Symposium on Applied Surface Analysis, Minneapolis, June 1991.

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d. Brief description of project

This program focused on surface and interface properties of high temperature superconductors. Its goal was to develop an understanding of surface degradation and passivation when overlayers or contacts were formed. Such studies are directly related to "weak links" and device structures. The program was initiated 9/1/88 with a 28-month commitment of \$250K.

e. Significant results of the project

Throughout this program, we sought fundamental insight into evolving interfaces based on the high temperature superconductors. At various times, we examined each of the HTS materials (LSCO, YBCO, BSCCO, TBCCO, BaKBiO) using photoemission and inverse photoemission, first to determine the clean surface electronic structure and then to determine the changes induced by the condensation of metallic, semiconducting, and gas phase species. That work led to approximately 40 refereed publications, 4 book chapters, 15 invited papers, and 1 patent. We were particularly pleased with the response of the community and the recognition of our contributions.

Our studies showed that overlayer species could be distinguished according to whether they were more reactive with oxygen or less reactive with oxygen than the Cu-O planes and chains of the superconductors. This thermodynamic distinction made it possible to determine which overlayers will induce surface disruption characterized by oxygen withdrawal, a change in the crystal structure of the HTS surface, and the conversion from metallic to insulating character. Our work provided insight into overall stabilities and degrees of stability for the different HTS materials and the overlayers.

Our studies demonstrated the feasibility of forming passivating layers on the HTS surface. This work ultimately led to a patent for CaF_2 passivation and a claim for rights for a process developed that shows that oxides can be formed by deposition in an activated oxygen environment.

In other studies, we explored the surface structure of cleaved BSCCO using photoemission with $\sim 10 \mu\text{m}$ spatial resolution. The photoelectron microscope images revealed the laminated structure of the surface in which thin sheets of single crystals with a typical dimension of $1 \times 1 \text{ mm}^2$ had highly stepped borders. PEM spectra obtained as a function of distance across these complex structures demonstrated inhomogeneous bonding configurations with Bi atoms that are highly oxidized at the edge of each crystal.

During the concluding part of the program, we examined growth of overlayers on HTS surfaces using our cluster-assembly technique. The idea was to bring preformed metallic or semiconducting clusters into contact with the clean HTS surface under ultrahigh vacuum conditions. The results showed minimal chemical intermixing and surface damage. Also during this period, we examined overlayer growth at low temperature. In this case, the idea was to form an overlayer at 20 K so that kinetic constraints on oxygen diffusion from the HTS would be severe. These studies were also successfully completed, and the results showed that a much less damaged surface would be prepared in this fashion.

h. Graduate students and post-doctorals who worked on project

Yongli Gao, postdoc
Harry Meyer, postdoc
Tadahiro Komeda, postdoc
Dan Waddill, postdoc
Tim Ohno, postdoc
Neal (Y.-N.) Yang, postdoc
Don Hill, graduate student
Tom Wagener, graduate student
Mike Jost, graduate student
Paul Benning, graduate student
Jeff (Y.-J.) Hu, graduate student